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16. Abstract

Twenty-six herbicides used alone or in combinations were applied to African rue. The rate of application of each herbicide was determined by the recommended label rate. An exception was the rate of diuron applied, which surpasses the recommended label rate.

Eight herbicides resulted in control of at least 50 percent of the African rue after a period of 7½ months or longer. Tebuthiuron, Vel 5026 and diuron applied in July resulted in the highest significant control 10½ months after treatment. Glyphosate, tebuthiuron, bromacil, diuron, and Vel 5026 resulted in the highest significant control of African rue with an October application 7½ months following treatment.

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PRELIMINARY CONTROL OF AFRICAN RUE (PEGANUM HARMALA L.) WITH VARIOUS HERBICIDES

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Establishment and Management of Roadside Vegetation
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TEXAS TRANSPORTATION INSTITUTE
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The research was conducted from the Texas A&M University Agricultural Experiment Station, P. O. Box 1658, Vernon, Texas 76384.

ABSTRACT

Twenty-six herbicides used alone or in combinations were applied to African rue. The rate of application of each herbicide was determined by the recommended label rate. An exception was the rate of diuron applied, which surpasses the recommended label rate.

Eight herbicides resulted in control of at least 50 percent of the African rue after a period of 7½ months or longer. Tebuthiuron, Vel 5026 and diuron applied in July resulted in the highest significant control 10½ months after treatment. Glyphosate, tebuthiuron, bromacil, diuron, and Vel 5026 resulted in the highest significant control of African rue with an October application 7½ months following treatment.

Key words: Vegetation control, roadsides, vegetation management.

SUMMARY

Herbicides tested varied in effectiveness by date of application. Summer applications of substituted urea herbicides effectively controlled growth of African rue (*Peganum harmala* L.), but the control achieved was not fully exposed until the following spring. Herbicides, diuron {3-(3,4-dichlorophenyl), 1-dimethylurea}, tebuthiuron {N-5(1,1,dimethylethyl)-1,3,4-thiadiazol-2-yl)-N, N-dimethylurea}, Vel 5026 {experimental herbicide}, bromacil {5-bromo-3 sec-butyl-6 methyluracil} and bromacil plus diuron were most effective in controlling African rue when applied in July. There was no significant difference in control with diuron at 45 kg/ha and tebuthiuron or Vel 5026 at 4.5 kg/ha. Bromacil (9.0 kg/ha) and bromacil plus diuron (6.8 kg/ha) applications resulted in at least a 50 percent control.

Early spring growth of African rue was effectively controlled by a previous fall application of glyphosate {N-(phosphonomethyl) glycine}, amitrole {3-amino-s triazole}, tebuthiuron, diuron, bromacil, RP 23465 {N'-(3-chloro-4(5-(1,1-dimethylethyl)-2-oxo-1,3,4-oxadiazol-3-(2*H*)-yl)phenyl)-N,N-dimethylurea} and Vel 5026 when applied in October. There was no significant difference in control of African rue with tebuthiuron (4.5 kg/ha), Vel 5026 (4.5 kg/ha), glyphosate (3.4 kg/ha) diuron (45.0 kg/ha), or bromacil (9.0 kg/ha). Amitrole (4.5 kg/ha) and RP 23465 (6.8 kg/ha) applications resulted in control of at least 50 percent of the African rue.

IMPLEMENTATION STATEMENT

The preliminary results of these test indicate that African rue can be chemically controlled. Concentration and time of application are not fully defined.

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INTRODUCTION

African rue was introduced into the United States about the time of World War I near Deming, New Mexico (2). It was first collected and identified in Texas in 1938 near the town of Pecos.

Heaviest infestations in Texas now occur near Pecos (Figure 1). Even though African rue is poisonous to cattle, sheep and probably horses (3.4), known losses are few. Nevertheless, its potential toxicity should be recognized and the plants controlled.

African rue is a member of the plant family Zygophyllaceae (Figure 2). It is a bright green, succulent, many branched perennial herb growing about 1 m high. The leaves are alternate, fleshy, and divided into narrow segments. The thick flower petals, usually five, are pure white and entire. The fruit is a leathery capsul containing 45 to 60 dark brown angled seeds.

Sites devoid of vegetation, such as highway shoulders bladed systematically and fields no longer cultivated, are readily invaded by this pest and others. Once established, perennial plants of African rue are not easily controlled and are considered a seed source for infesting adjacent grazing lands.

Effective controls for this species have not been developed. Grubbing has been suggested, but as early as 1949 it was evident that the plant could not be eradicated by merely grubbing (2). Use of herbicides in the past has not been successful in experimental trials. Studies on controlling African rue have been performed on an opportunity basis, and few of them have been reported (1).

Current tests were installed on roadsides infested with African rue (a) to determine the susceptibility of African rue to herbicides and (b) to catalog the herbicidal response of plants associated with African rue preparatory to installing a competitive vegetative cover to limit establishment of rue plants.

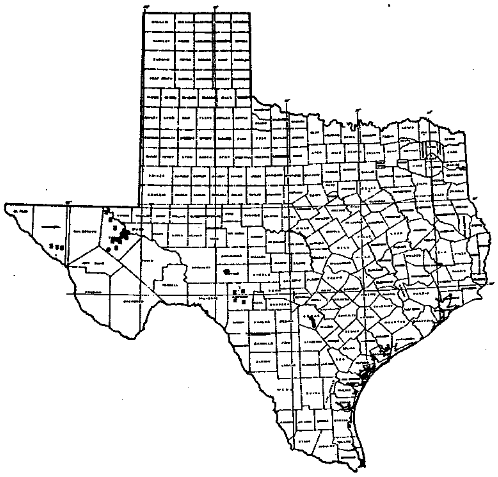

Figure 1. Distribution of African rue in the State of Texas. Courtesy of Texas Agricultural Experiment Station.

Figure 2. A typical African rue plant in flower. Courtesy of Texas Agricultural Experiment Station.

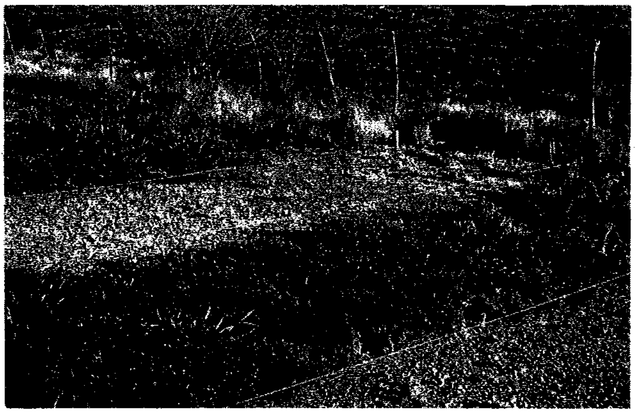

Figure 3. African rue spray plots located 18 miles north of Ft. Stockton, Texas on U. S. 285. Picture shows plot size, density of African rue and control. It was taken April 2, 1975.

MATERIALS AND METHODS

Experimental plots $28m^2$ in size were established in Pecos and Ward counties of District 6, State Department of Highway and Public Transportation (Figure 3). Treatments are shown in Table 1. Liquid formulations were applied in a total volume of 138.4 ml/m^2 with a 7.6 liter hand sprayer equipped with a cone-type adjustable nozzle. Granular herbicides were broadcast by hand. Treatments were installed in July, 1974 and in October, 1974. Evaluations were made May 23, 1975. Three replications were used at each treatment location. African rue and other plant species (Table 1) present in the experimental plots were counted prior to treatment and periodically following herbicide application.

Conditions for plant growth at the time of the summer application were poor. Soil moisture was low and the atmospheric temperature high (Table 2). Conditions at the time of fall applications were much improved with good soil moisture and warm temperatures; however, most of the plants were nearing maturity.

RESULTS AND DISCUSSION

Herbicides of the substituted urea family such as diuron (Figure 3), tebuthiuron, RP 23465, and monuron were most effective of the summer treatments for the control of African rue (Table 3). Not all of the substituted ureas functioned equally well. Tebuthiuron at 4.5 kg/ha performed almost as well as diuron at 45.0 kg/ha (Table 3). Other chemicals showing some promise as a possible treatment for summer application were bromacil, Vel 5026, and bromacil plus diuron.

Other herbicides applied in October were effective on African rue. Glyphosate and tebuthiuron resulted in higher control percentage than any other chemical (Table 3). Amitrole, bromacil, diuron, RP 23465 and Vel 5026 were also effective in reducing the number of plants per plot. Surviving plants treated with amitrole were chlorotic and stunted at the time of evaluation.

These preliminary evaluations indicate that the substituted ureas or glyphosate are effective materials to control African rue. Final evaluations will be made in the Fall of 1975.

Early summer or fall application (Table 4) of bromacil, bromacil plus diuron, RP 23465 and Vel 5026 were effective in controlling sand dropseed and silver bluestem. Plots treated with tebuthiuron in the early summer had no effect on sand dropseed or red threeawn, and resulted in a 34 and 301% increase respectively, with a fall treatment. Tebuthiuron reduced the population of silver bluestem at both treatment times (Table 4). An early summer application of glyphosate was ineffective in control of any species, but a fall application reduced the population of the three major grass species and African rue. Red threeawn is apparently more resistant to herbicides than the other two species. Buffalograss was present in some plots and was generally affected adversely by most of the herbicides; however, glyphosate did not kill the plants. Tebuthiuron treatment of buffalograss stimulated plant size. Tebuthiuron did not effect tobosagrass, while glyphosate, RP 23465, Vel 5026 and diuron reduced the population. Pink pappusgrass and white tridens were affected adversely by all herbicides except tebuthiuron.

These preliminary data indicate a degree of specificity of several herbicides. Their effects on African rue and associated species are being investigated further, to determine which herbicide will control African rue and not harm the desirable residual vegetation. During 1975 the most promising herbicides will be evaluated to determine the most effective rate and date of application. A further research concern will be to establish a cover of desirable plants with the control of African rue, using the information developed on grass tolerance to herbicides.

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Table 1. Plant species present in some or all plots treated for control of African rue. Not all of the species were treated with all of the materials.

Common name	Binomial name
Sand dropseed	*Sporobolus cryptandrus* (Torr.) Gray
Silver bluestem	*Bothrichloa saccharoides* (Swartz) Rydb.
Red threeawn	*Aristida longiseta* (Steud.)
Fluffgrass	*Erioneuron pulchellum* (H.B.K.) Tateoka
Gray goldaster	*Heterotheca canesiens* (DC.) Shinners
Tobosagrass	*Hilaria mutica* (Buckl.) Benth.
Pink pappusgrass	*Pappophorum bicolor* Fourn.
Buffalograss	*Buchloe dactyloides* (Nutt.) Engelm.
Burrograss	*Scleropogon brenifolius* Phil.
Scarlet globemallow	*Sphaeralcea coccinea* (Pursh.) Rydb.
Indian rushpea	*Hoffmanseggia densiflora* Beuth. ex. Gray
White tridens	*Tridens abbescens* (Vasey) Woot. and Standl.
Hairy tridens	*Erioneuron pilosum* (Buckl.) Nash
Perennial broomweed	*Xanthocephalum microcephalum* (D.C.) Shinners
Twoflower trichloris	*Chloris crinita* Lag.
Silverleaf nightshade	*Solanum elaeagnifolium* Car.

Table 2. Daily precipitation records (Fort Stockton, Texas) prior to and following herbicide applications

	Daily precipation (cm)												
	1974								1975				
	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
1.	1.88												
2.				0.05		HA[1]			0.03	0.53			
3.		0.15								0.38			
4.		0.81		2.54						0.46			
5.										0.30			
6.				0.89			2.36						
7.													
8.													
9.							0.76						
10.	0.28						1.42						
11.								0.05	0.38				1.45
12.				0.41					0.03				
13.		0.13				1.40					0.46		0.03
14.						1.65							
15.						0.41							
16.					1.27					0.03			
17.					0.89								
18.					0.38								
19.					3.53								
20.			1.40		3.56								0.08
21.					2.16								
22.				0.08	1.78								
23.				1.40	1.17				1.27	0.86			
24.				1.63	2.69	1.63			0.86				
25.			HA	0.89	1.09	0.10							
26.				0.63	0.08			1.19					
27.				1.04		0.08							
28.				0.13		0.25							
29.													0.38
30.			0.18	0.03						0.97			
31.						0.38		0.20	0.05				
Total	2.16	1.09	1.58	9.72	18.60	5.90	4.54	1.44	3.59	2.56	0.46	0.00	1.94

[1]Date of Herbicide Application

Table 3. Percentage control of African rue with various herbicides 10½ and 7½ months following application.

Chemical[4/]	kg/ha Rate[5/]	Time of Application (Percentage Control[1/]) 7/25/74	10/2/74
Amitrole	4.5	6.4 ef [2/]	65.0 bcd
Asulam	6.8	37.6 cde	27.4 egh
Bromacil	9.0	52.9 bc	81.0 ab
Bromacil + diuron	3.4 + 3.4	51.3 bcd	41.2 def
Bromoxynil	2.3	8.1 ef	17.8 fgh
Check	0	0.0 f	0.0 h
2,4-D	4.5	10.1 ef	7.1 gh
2,4-DB	2.3	4.9 ef	10.9 gh
2,4-DEP	2.3	3.0 f	NA[3/]
2,4-D + dicamba	2.3 + 1.1	12.1 ef	17.9 fgh
Dicamba (DMA)	2.3	10.1 ef	1.6 h
Dicamba (granular)	1.1	17.6 ef	4.2 gh
Diuron	45.0	93.9 a	74.0 abc
Fenac	20.3	9.2 ef	10.1 gh
Glyphosate	3.4	15.6 ef	92.5 a
Kartibulate	11.3	0.0 f	NA
Methazole	2.3	6.6 ef	15.8 fgh
Monuron	1.7	21.2 def	10.8 gh
Picloram	2.3	26.0 cdef	30.3 eg

Table 3. (Continued)

Chemical[4/]	kg/ha Rate[5/]	Time of Application (Percentage Control[1/]) 7/25/74	10/2/74
RP 20630	6.8	8.1[ef]	21.8[fgh]
RP 20810	6.8	10.1[ef]	13.3[fgh]
RP 23465	6.8	37.8[cde]	53.3[cde]
Tebuthiuron	4.5	84.1[a]	90.3[ab]
2,4,5-TP	2.3	14.7[ef]	18.2[fgh]
Vel 5026	4.5	76.2[ab]	71.7[abc]
Vel 5028	4.5	8.6[ef]	NA
Vel 5052	4.5	9.8[ef]	14.6[fgh]

[1/]Represents the means of 3 replications.

[2/]Means within each column followed by the same letter are not significantly different at the 5% confidence level.

[3/]NA - Not applied

[4/]See Appendix I for accepted chemical name.

[5/]1.0 kg/ha = 0.892 lbs/A.

Table 4. Percentage reduction of three major grass species 10½ and 7½ months following herbicide application.

Chemical[2/]	Rate kg/ha[4/]	Percentage Reduction[1/] by species[3/] — Time of Application 7/25/74 Scr	Bsa	Alo	10/2/74 Scr	Bsa	Alo
Amitrole	4.5	0.0	0.0	0.0	0.0	0.0	0.0
Bromacil	9.0	85.0	80.0	75.0	100.0	100.0	100.0
Bromacil + diuron	3.4 + 3.4	70.0	93.0	83.3	95.0	100.0	80.0
Diuron	45.0	93.4	100.0	83.3	89.7	100.0	56.7
Glyphosate	3.4	0.0	0.0	0.0	95.2	73.2	30.0
RP 23465	6.8	97.7	95.0	93.3	100.0	100.0	68.6
Tebuthiuron	4.5	0.0	45.0	0.0	0.0	82.5	0.0
Vel 5026	4.5	48.3	86.7	0.0	75.8	91.3	70.5

[1/] Represents the means of 3 replications

[2/] See Appendix I for accepted chemical name

[3/] Symbols represent the binomial plant name

[4/] 1.0 kg/ha = 0.892 lbs/A.

	Bionomial name	Common name
Alo	Aristrida longiseta, Steud.	Red threeawn
Bsa	Bothriochlora saccharoides (Swartz) Bydb.	Silver bluestem
Scr	Sporobolus cryptandrus (Torr.) Gray	Sand dropseed

APPENDIX I

COMMON NAME	CHEMICAL NAME
Amitrole	3-amino-s-triazole
Asulam	Methyl sulfanilylcarbamate
Bromacil	5-bromo-3-sec-butyl-6 methyluracil
Bromoxynil	3,5-dibromo-4-hydroxybenzonitrile
2,4-D	(2,4-dichlorophenoxy) acetic acid
2,4-DB	4-(2,4 dichlorophenoxy) butric acid
2,4-DEP	tris {2-(2,4-dichlorophenoxy) ethyl} phosphite
Dicamba (DMA)	Dimethylamine salt of 3,6-dichloro-o-anisic acid
Dicamba (granular)	3,6-dichloro-o-anisic acid
Diuron *	3-(3,4-dichlorophenyl)-1, 1-dimethylurea
Fenac	(2,3,6-trichlorophenyl) acetic acid
Glyphosate	N-(phosphonomethyl) glycine
Kartibutilate*	tert-butylcarbamic acid ester with 3-(m-hydroxy-phenyl)-1,1-dimethylurea
Methazole	2-(3,4-dichlorophenyl)-4-methyl-1,2,4-oxadio-zolidine-3,5-dione.
Monuron*	3-(p-chlorophenyl)1,1-dimethylurea
Picloram	4-amino-3,5-6-trichloropicolinic acid
RP 20630	Experimental herbicide
RP 20810	Experimental herbicide
RP 23465*	N'{3-chloro-4-{5-(1,1-dimethylethyl)-2-oxo-1,3,4-oxadiazol-3-(2H)-yl}phenyl}-N,N-dimethylurea
Tebuthiuron*	N-{5-(1,1-dimethylethyl)-1,3,4-thiadizol-2yl}-N,N' dimethylurea
2,4,5-TP	2-(2,4,5-trichlorophenoxy) propionic acid
Vel 5026	Experimental herbicide
Vel 5028	Experimental herbicide
Vel 5052	Experimental herbicide
Control	No treatment

*Substituted urea herbicide